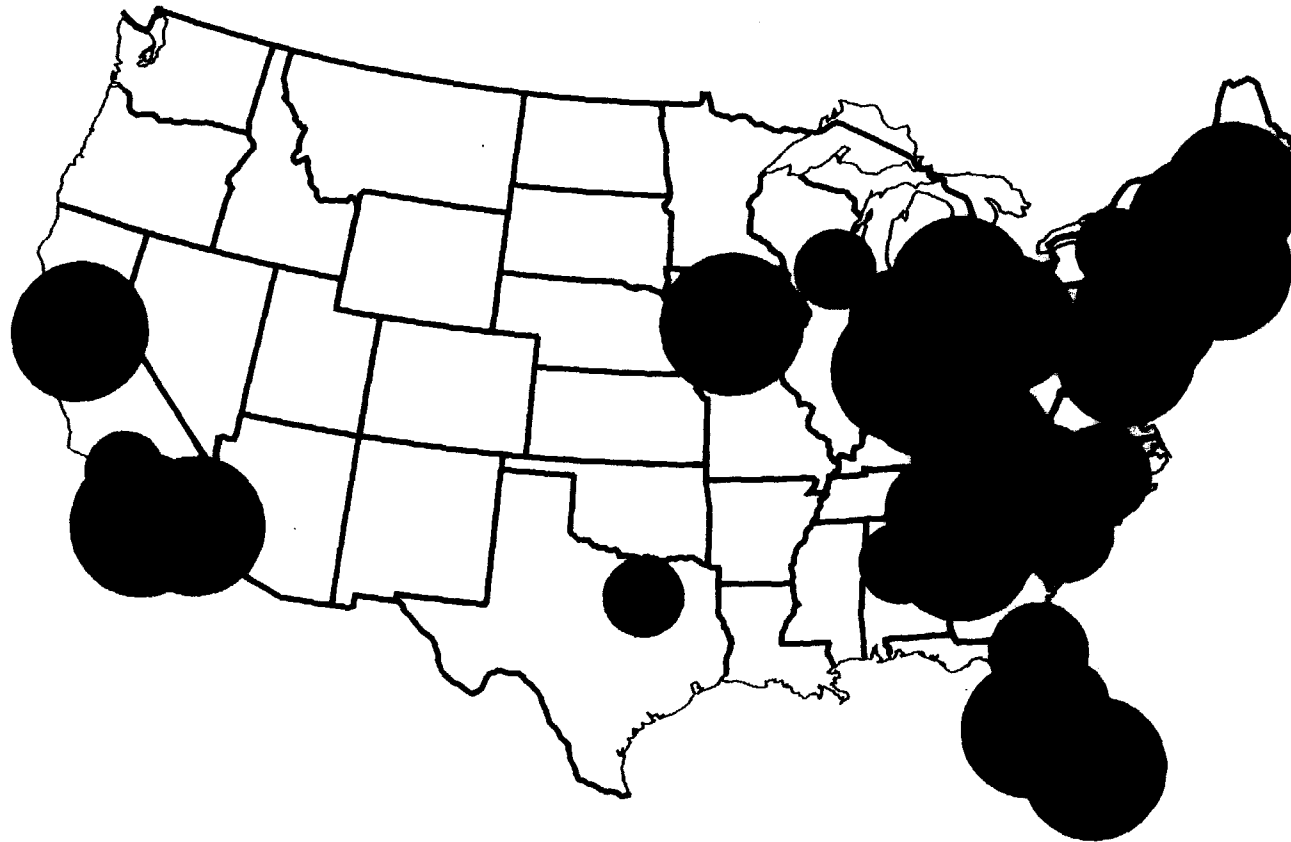


54-30-00 N  
125-00-00 W

54-30-00 N  
62-15-00 W



17-00-00 N  
125-00-00 W

17-00-00 N  
62-15-00 W

Stations on & adj. to channels 69 - 69

Plan file: plan\_100996.dat

Stations are NTSC (Red) and ATV (Blue)

Date: 10 17 96

Scale points 37.00/ 94.00/\*\*\*\*\*



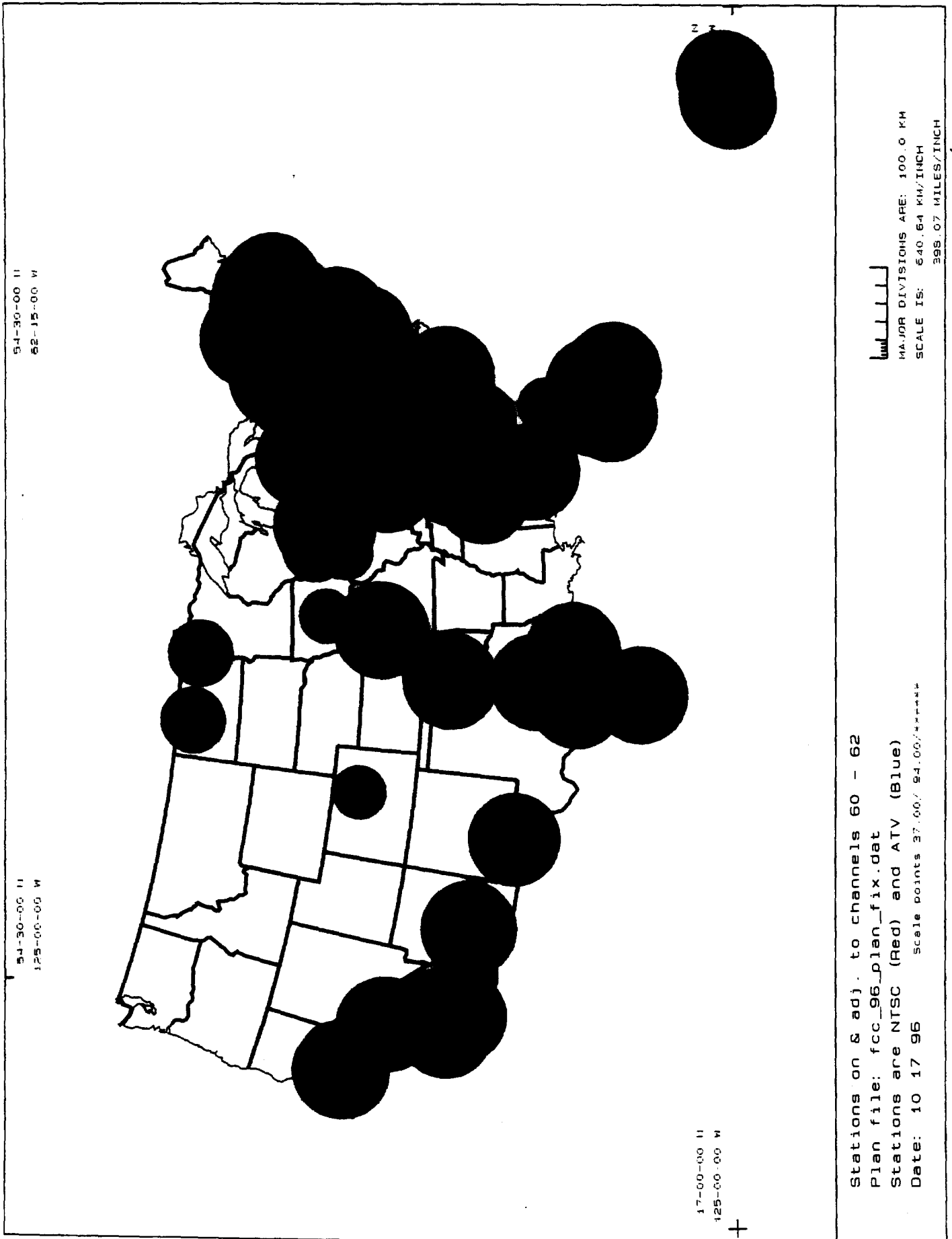
MAJOR DIVISIONS ARE: 100.0 KM

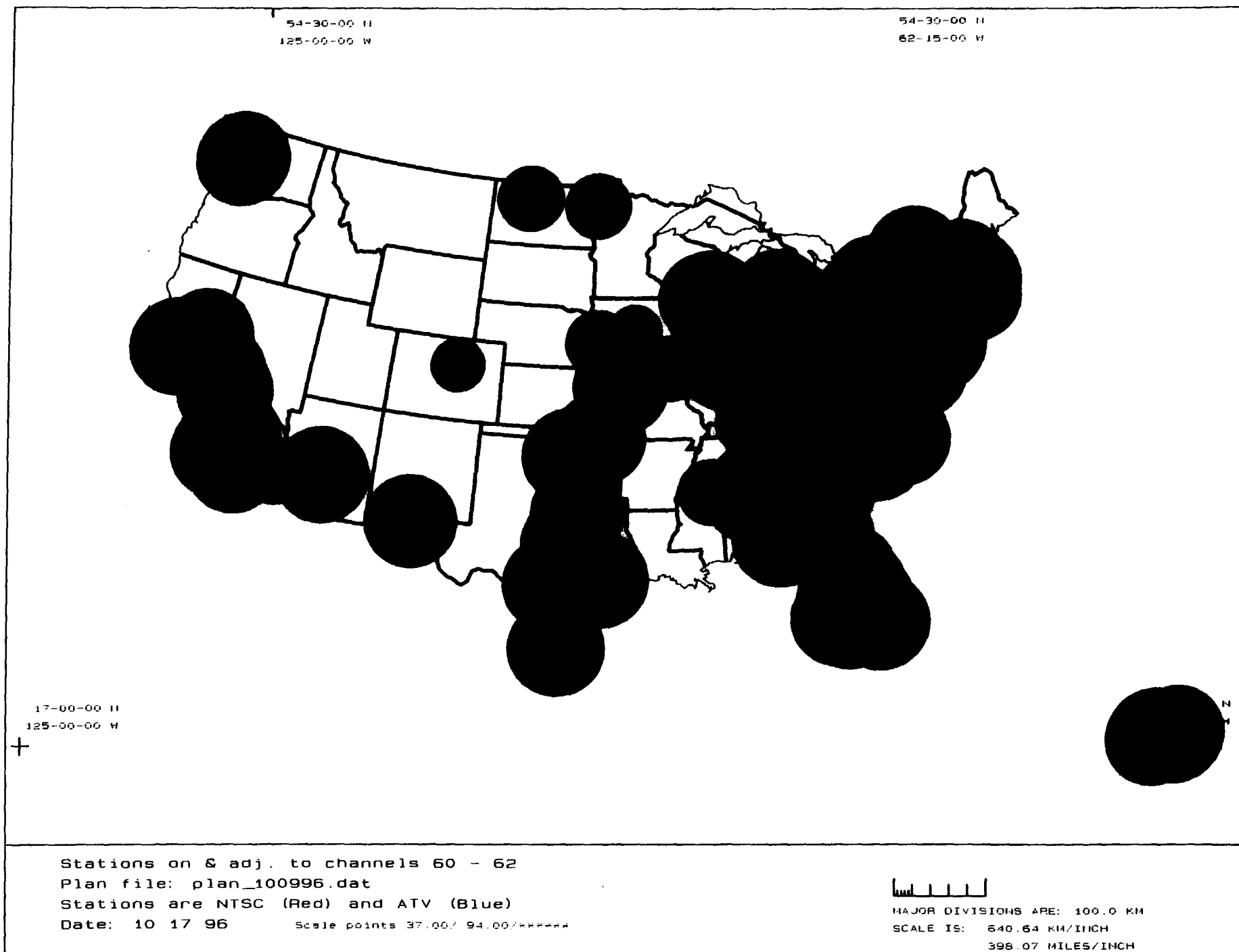
SCALE IS: 640.64 KM/INCH

398.07 MILES/INCH

BROADCASTERS' MODIFIED TABLE --  
CHANNEL 69

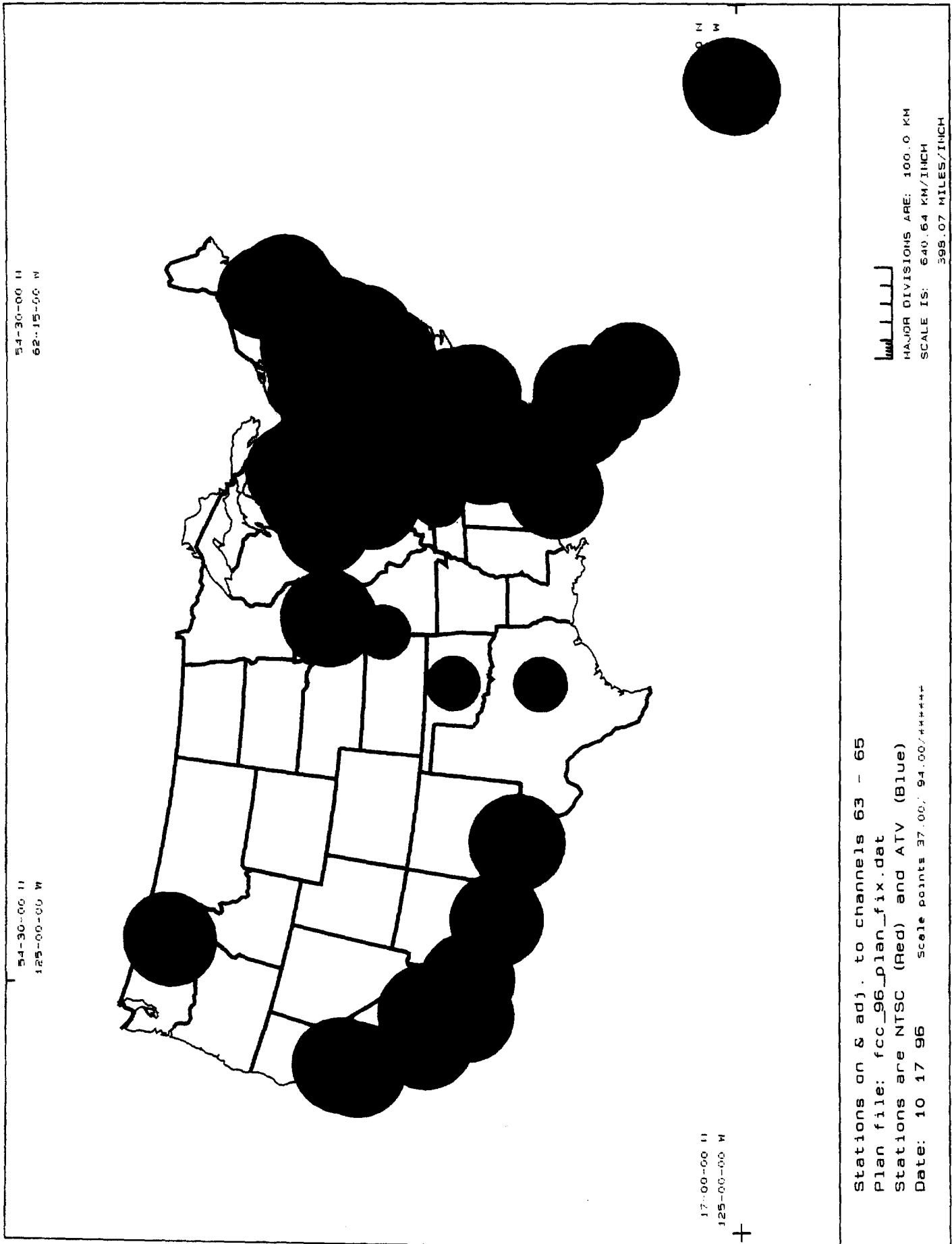
# BASELINE TABLE (CORRECTED FCC DTV TABLE) -- CHANNELS 60-62

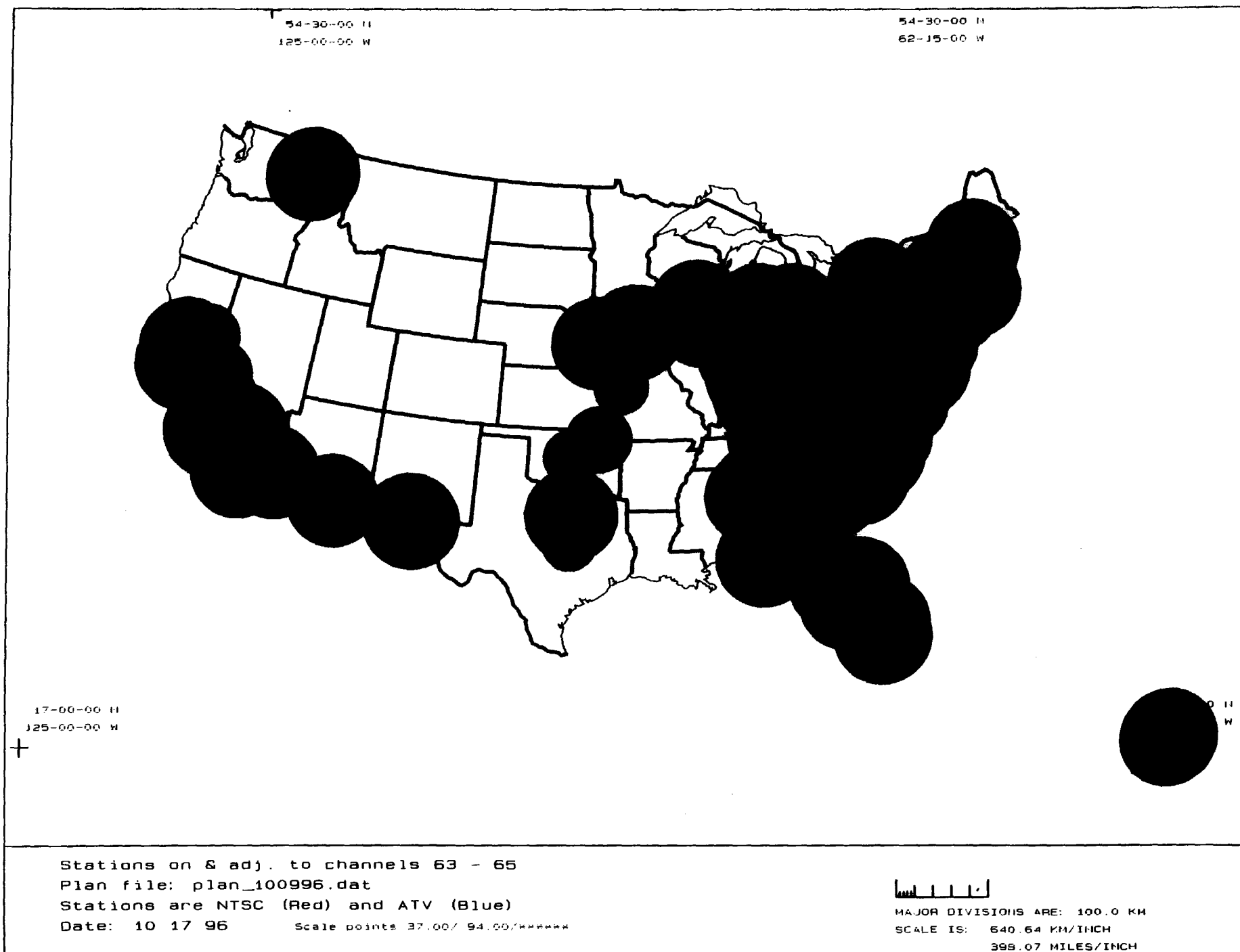


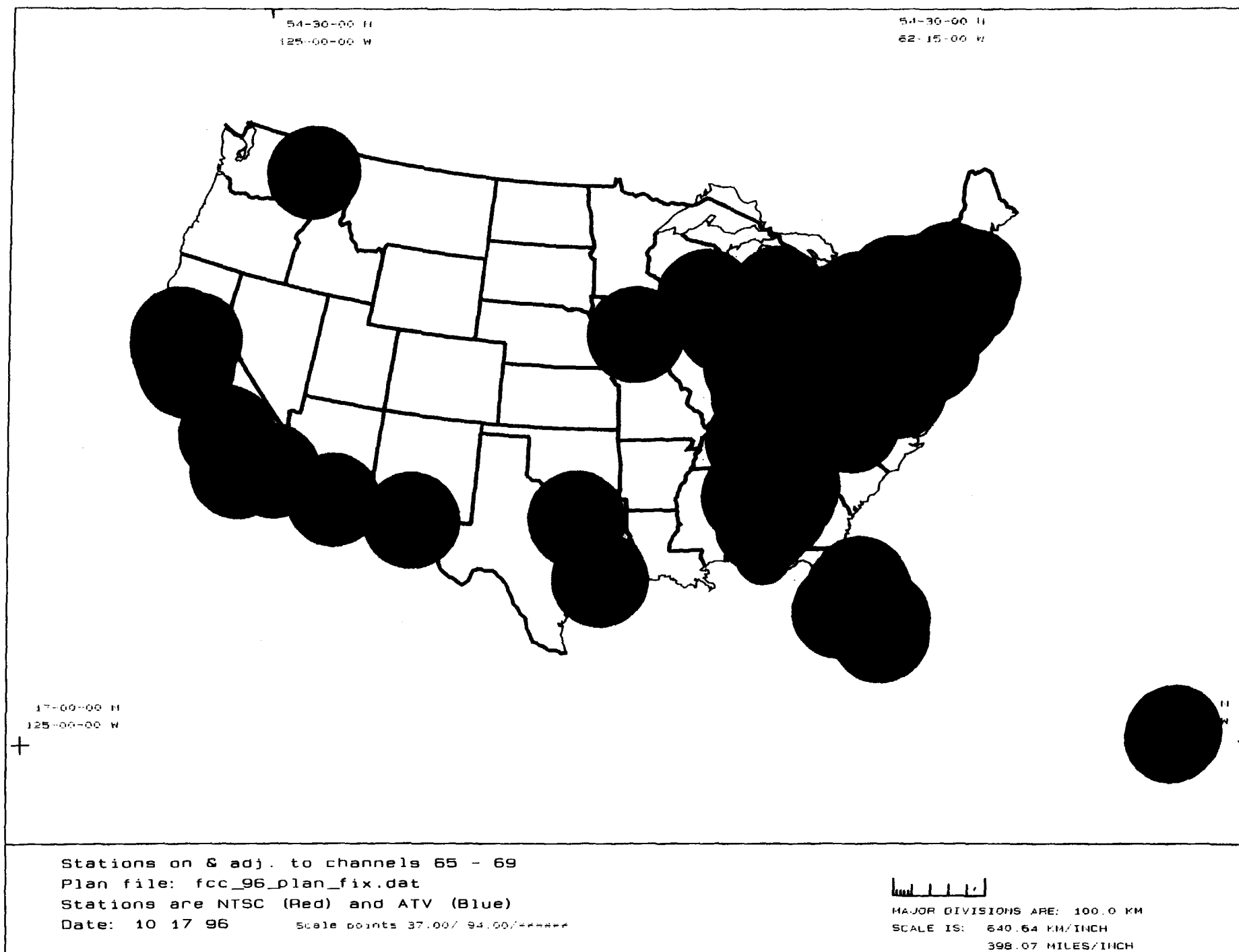


BROADCASTERS' MODIFIED TABLE --  
CHANNELS 60 - 62

BASELINE TABLE (CORRECTED FCC  
DTV TABLE) -- CHANNELS 63-65

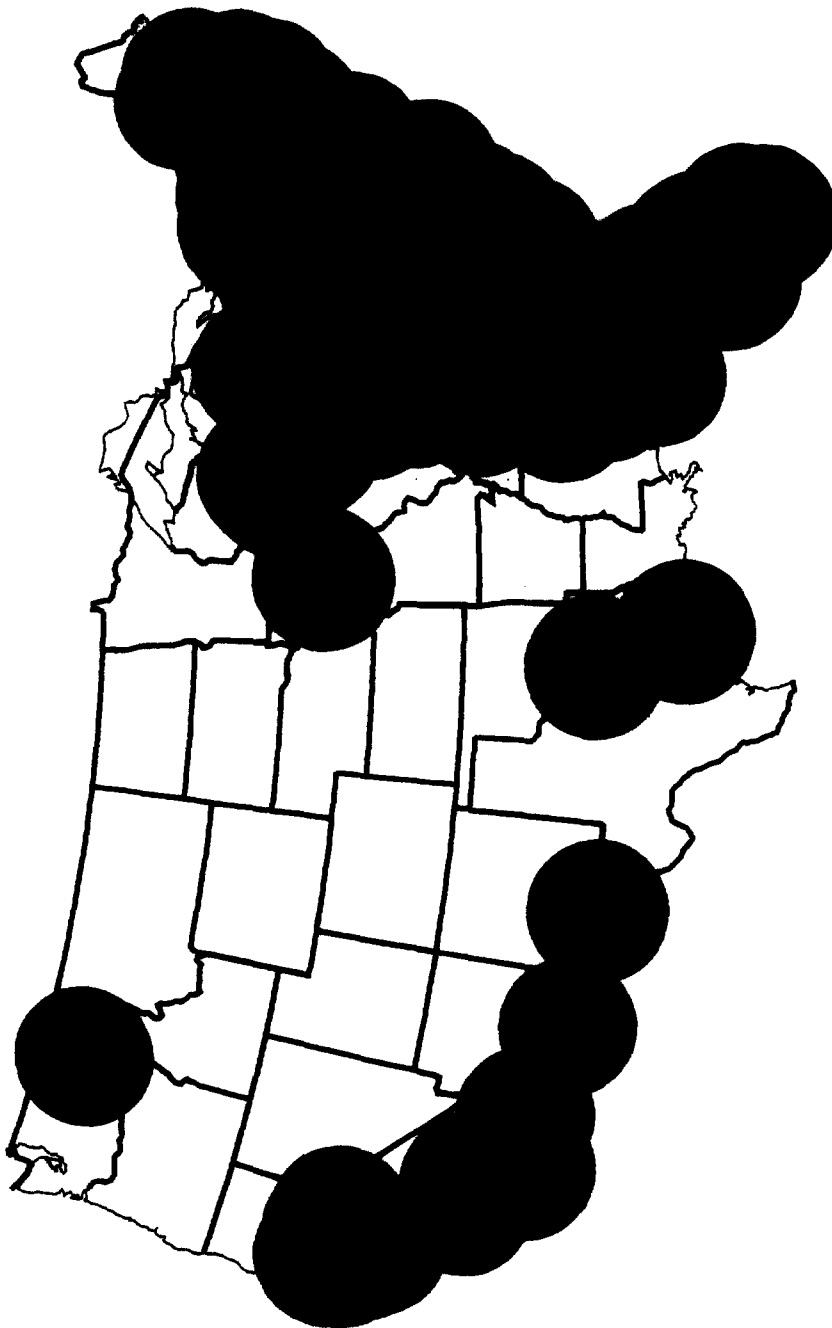






BASELINE TABLE (CORRECTED FCC  
DTV TABLE) -- CHANNELS 65-69

54-30-00 11 00-00-1-5  
M 00-51-29



11 00-06-15  
M 00-06-21

17-00-00 11  
125-00-00 H

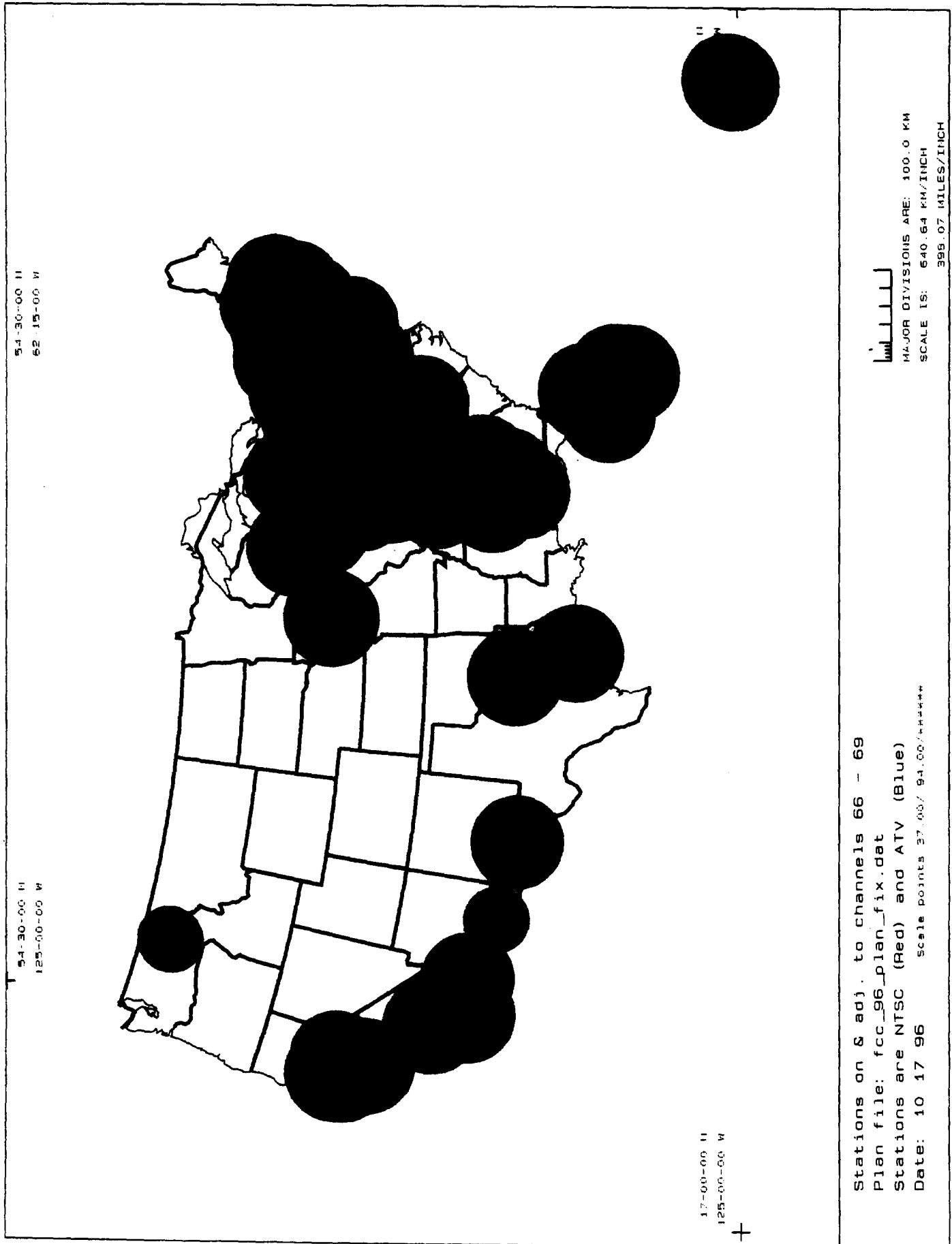
```

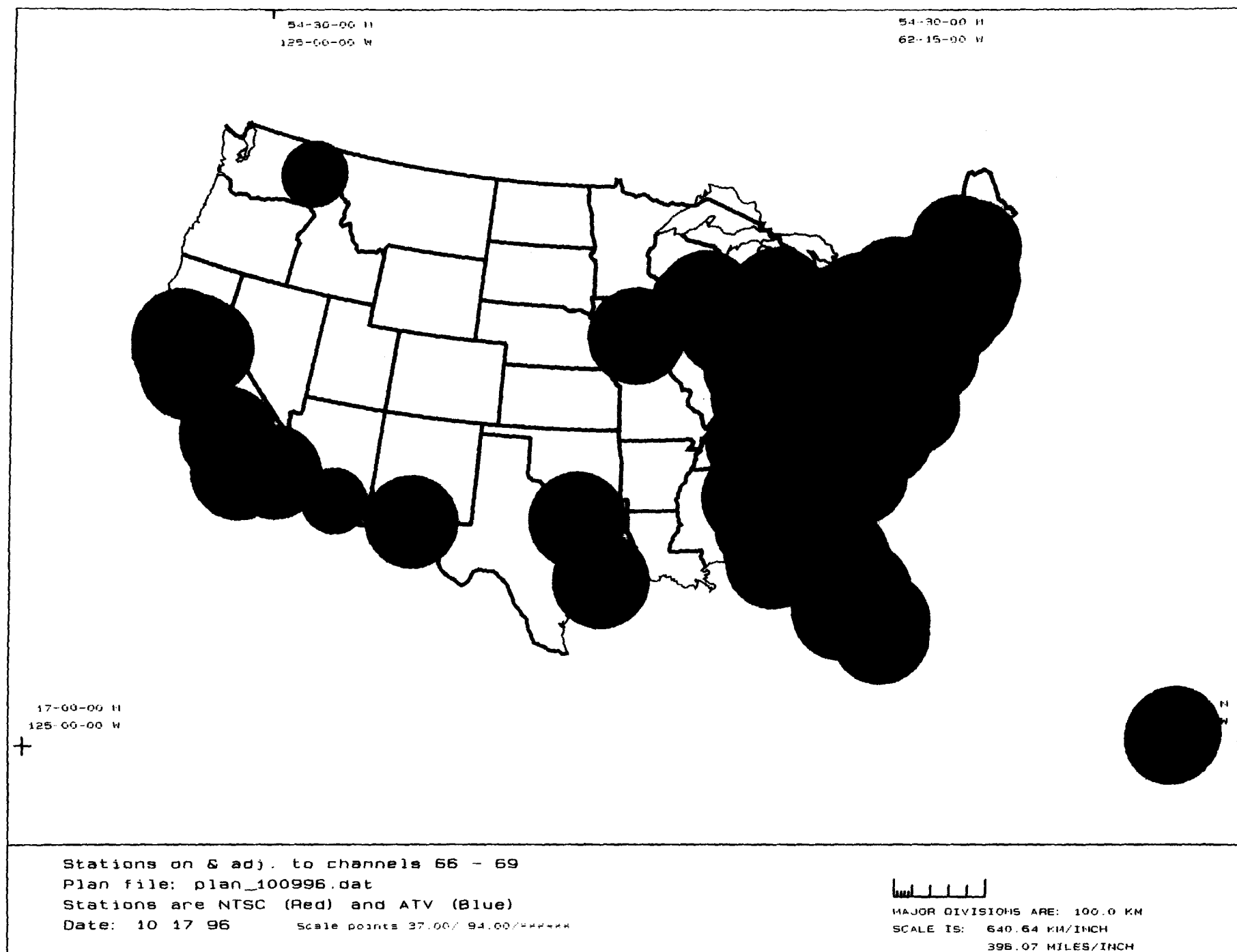
Stations on & adj. to channels 65 - 69
Plan file: plan_100996.dat
Stations are NISC (Red) and ATV (Blue)
Date: 10 17 96      Scale points 37.00/ 94.00/-----

```

MAJOR DIVISIONS ARE: 100.0 KM  
SCALE IS: 640.64 KM/INCH  
398.07 MILES/INCH

BASELINE TABLE (CORRECTED FCC  
DTV TABLE) -- CHANNELS 66-69





BROADCASTERS' MODIFIED TABLE --  
CHANNELS 66 - 69





**DESCRIPTION OF THE BROADCASTERS'  
DTV CHANNEL ASSIGNMENT MODEL**

The following describes how the Broadcasters' computer model is crafted to produce a table of ATV assignments that will maximize achievement of the following goals:

- (a) provide an ATV channel for each current NTSC station;
- (b) replicate each NTSC station's service area with the new ATV channel;
- (c) minimize the interference to existing NTSC service.

Since DTV will be operating in the same spectrum bands as the NTSC service, DTV stations must be "squeezed in" among the same number of existing NTSC stations without causing unacceptable interference to existing stations or the new DTV channels. This assignment problem is so large as to be nearly infinite so that a successful solution to such a problem requires the use of a carefully structured approach.

The model comprises two principal software programs. The first program, referred herein as the **Assignment Model**, assigns DTV channels for each geographic area based on minimum geographical separation distances. The second program, referred herein as the **Coverage and Interference Model**, refines this selection to optimize the assignments to maximize coverage and minimize interference.<sup>1</sup> The coverage and interference program has the option of using either the FCC R-6602 Curves or the Longley-Rice terrain-dependent model, for computing coverage and interference. The **Coverage and Interference Model** can change the original channel assignments, and can evaluate using additional channels where terrain blocking may permit stations to operate at closer spacing.

The model assumes exact (same tower) co-location of the new DTV transmitter with its paired NTSC transmitter, and also assumes the same antenna height and coverage pattern for DTV and NTSC paired channels.

**I. Model Description**

**A. Creation of Initial Table and the Pool of DTV Available Channels**

The first step in the development of a table is to generate an initial table that pairs existing NTSC stations with specific DTV assignments. The initial paired Table is created using the **Assignment Model** which uses minimum separation distances to determine the number of existing stations that can be accommodated with an additional DTV channel under different co-channel, and/or adjacent channels or taboos' distances specified by the

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<sup>1</sup> For a more detailed description of the model, refer to Bill Meintel, "Spectrum Studies for Advanced Television Service in the U.S.", 1994 Proceeding of the NAB Broadcast Engineering Conference.

user. This is accomplished by first ranking the existing NTSC stations for a given area in order of difficulty of finding a channel for them, and then using a mathematical optimization method to find the largest number of stations that can be accommodated within that area. Some of the criteria used by the model to develop the initial table are:

**Congested Markets First:** In the less congested markets, there will be a larger number of eligible DTV channels than there are NTSC stations. In the more congested markets and their outlying area, there may be the same number of eligible DTV channels as there are NTSC stations. Given these relative constraints, it became apparent from the outset that the **Assignment Model** would assign channels first in those core markets where channel congestion is the worst and then moving out to the less congested markets where there are fewer constraints.

Thus, for example, since there are available only the same number of DTV channels for the New York City market as there are NTSC stations in that market, it made sense for the model to start with the assumption that those channels would be used in New York City, rather than in the adjacent markets of Scranton, Bridgeport or Utica.

**VHF and UHF:** The model selects eligible channels for each station without regard to whether a VHF or UHF channel is being considered.

In addition to generating an initial paired table, the **Assignment Model** generates a list of available channels for each station that was assigned an DTV channel. This list of available channels is used by the **Coverage and Interference Model** to improve upon the initial paired table by substituting channels where appropriate to minimize NTSC interference and maximize coverage for DTV stations.

## **B. Analysis and Modification of Initial Table**

The above-described process yields a list of DTV channels that are eligible for use in each station in the market. This list provides the starting point for the evaluation of the actual coverage and interference of all the channels that are available on that list, including the channels that were assigned in the initial table. Specifically, the **Coverage and Interference Model** "tries out" each of the eligible DTV channels for all the stations in a market by calculating the overall effect of each option, using either the FCC R-6602 Curve or the Longley-Rice terrain-dependent propagation model, the planning factors specified in Appendix A and the Grand Alliance system performance parameters specified in Appendix B. Because of the "daisy chain" effect, each option can have different coverage and interference ramifications on the same and adjacent markets. The model picks the "best" DTV channel for each NTSC station in the market, as determined by the priorities listed below, and the parameters and rules that follow, thereby maximizing DTV service and minimizing interference to NTSC viewers.

## 1. Priorities

### a) Replication

The **Coverage and Interference Model** selects DTV channel assignments that provide the highest replication percentage of the paired NTSC channel's coverage. Specifically, the model evaluates the initial assignment in the initial paired table to determine whether full replication is achieved. If full replication is not achieved, the model tries to substitute channels from the list of available DTV channels that best replicate (match) the existing service area of the associated NTSC station. Prior to the evaluation, however, the list of available channels is ranked from lowest to the highest and is modified to eliminate any DTV channels that do not meet minimum channel spacing requirements. This arrangement avoids adjacent-channel interference in the same market. It is also helpful in achieving comparable service areas between the paired NTSC and DTV stations.

### b) Replication for Co-located NTSC Stations

For the situations where two or more NTSC stations are operating from the same tower and/or nearby sites (distance is specified by the user and generally set equal to zero), the model seeks to evaluate all of the DTV assignments on the same tower and/or nearby sites by attempting to optimize the replication for the entire group of stations rather than each station individually. This model, however, before applying this priority automatically assigns the adjacent channel to existing licensees (i.e., exact co-location), regardless of replication.

## 2. Optional Priority Setting

Maximization of Coverage: As a result of applying the replication principle, stations operating at less than maximum NTSC facilities are initially matched with DTV channels and facilities that will produce service areas that, accordingly, may be smaller than a maximum-facility NTSC station. This option allows stations with less than maximum facility to expand their DTV coverage by increasing power to the extent of the largest calculated DTV service areas in the same area in the same market, provided that such an expansion would not cause any new interference to existing NTSC or other DTV stations.

## II. Basic Parameters

NTSC Stations Database. The model uses a snapshot of the FCC database that includes the current NTSC licensees, approved construction permits and pending applications. The NTSC service area of each licensee is predicted using the information in the FCC engineering databases. The main database includes the location, power and heights of each transmission facility and a link to the FCC's antenna pattern database. DTV selection alternatives are constrained to existing television towers.

Antenna Pattern. The model uses the directional antenna patterns of stations as specified in the FCC engineering antenna pattern database. When no antenna pattern is in the

FCC's database, a standard omni-directional antenna pattern is used. The vertical pattern of the antenna is included in Appendix C.

Planning Factors. The planning factors and technical parameters developed by ACATS PS/WP3 are used by this model, except that the model substitutes 7 dB for the UHF receiver noise figure (See Appendix A). In addition, the model has an added option of using an antenna dipole adjustment factor to adjust required UHF power levels from the nominal center-of-UHF-band dipole factor that is used for the FCC propagation curves. This adjustment is described in more detail below under Dipole Factor Adjustment.

Dipole Factor Adjustment. The field strength required to deliver a given voltage at the receiver terminals is adjusted as a function of the UHF operating channel. The NTSC Grade B contour is determined using a constant dipole factor which is based upon median frequency for each of the low VHF, high VHF and UHF bands.

The reference predicted-contour for each NTSC station is adjusted using a factor for each UHF channel. The total adjustment range across the UHF band is 4.6 dB. Each channel's field strength is adjusted to equalize the delivered signal. This adjusted level is then the effective Grade B threshold level. Since the nominal Grade B value is based upon the center of the UHF band, this results in a 2.3 dB reduction for channel 14 and 2.3 dB increase for channel 69. The channels that are closer to the middle have smaller adjustments. There is no corresponding adjustment made for VHF frequencies since the adjustment factors between the center of both low VHF and high VHF and the edge of these bands are small.

NTSC Baseline. "NTSC Baseline" is defined as the area with the predicted service within the predicted Grade B Contour based on FCC F(50,50) propagation curves. The service area can be calculated using either the FCC Curves or the Longley-Rice Model. The Longley-Rice propagation prediction methodology, however, yields several improvements over the FCC model in that:

- It calculates the existing NTSC service (and prospective DTV service) by taking into account the effect of terrain and predicted interference.
- The Longley-Rice methodology also incorporates various factors that more accurately reflect propagation differences between low UHF and high UHF channels. The methodology adjusts for these differences when calculating the coverage and interference of both NTSC and DTV.

NTSC Service Area. "NTSC service area" is defined as the area within the predicted Grade B contour based on the FCC F(50,50) propagation curves as:

- (a) reduced by areas where interference is caused by other NTSC stations;
- (b) reduced by areas where interference caused by DTV stations exceeds acceptable levels as determined by laboratory test of the Grand Alliance prototype hardware at ATTC; and

- (c) reduced by areas that do not receive NTSC service due to terrain as predicted by the Longley-Rice methodology.

DTV Service Area. The "DTV service area" is defined as the area within this noise-limited contour based on the F(50,90) propagation curves after coverage is reduced:

- (a) by areas where interference from DTV or NTSC stations is deemed to be unacceptable: and,
- (b) where the effects of terrain reduce the signal level below the noise-limited service threshold.

It is recognized that the model can indicate large DTV power levels under certain conditions, for example, when attempting to replicate NTSC coverage of a VHF station with DTV coverage using a high UHF channel. The most significant differences occur for such stations whose antenna is not very high above the nearby terrain. Optimal engineering of such facilities may ultimately involve tradeoffs between the antenna height and other factors, resulting in different power levels.

Conversion of Service Area to Served Population. The model is designed to apply the replication criterion on the basis of square miles, not population. For each prospective DTV service area, the model calculates the population in that area as determined from the 1990 U.S. Census database. In most cases, replication of area substantially yields replication of population. However, when there is no such agreement between area and population, as can happen in anomalous cases, adjustments can be made to achieve replication by population and by areas, thus yielding the choice of a different and better channel. This is achieved by selecting another channel from the list of available channels.

### **III. Other Parameters and Guidelines**

RF Propagation Model. For evaluating DTV and NTSC service areas, the physical area being evaluated is divided into 360 evenly spaced radials extending from the transmitter site. Evaluations of predicted field strength are made every 1 km on each radial using the Longley-Rice propagation model that takes into account the specific terrain profile (using the U.S. Geological Survey terrain database) between the transmitter site and each receiving site. This terrain-based propagation model provides more realistic predictions of field strength than the traditional FCC curves that assume that all areas have the same "average" terrain roughness.

Adjacent Channel Spacing. A station that is not located on the same tower is defined as 'not co-located.' The model initially does not evaluate the suitability of DTV 'not co-located' on the adjacent channels that are closer than 80 km (~50 miles) to an NTSC channel. However, if there is an NTSC station that does not have an DTV station assigned after all candidates that meet all requirements are evaluated, the model attempts to select and evaluate DTV channels that violate either the close (i.e., non zero) spacing or distant spacing

by as little as possible. All violations of the spacing rules are printed on an exception report.

TV/Land Mobile Protection. The allotment/assignment program allows a minimum co-channel spacing of 240 km (~149 miles) between an DTV channel and channels that are allocated between channels 14 through 20 for land mobile use.

Canadian and Mexican Stations. Existing Canadian and Mexican NTSC stations and vacant allotments, as determined from the FCC's database, are protected using a 155 km (~96 miles) minimum co-channel and 80 km adjacent channel DTV-to-NTSC separation distance. No allowance is made for future Canadian or Mexican DTV assignments.

U.S. Vacant Allotments. Commercial vacant allotments are initially eliminated from consideration of DTV channels. Once a full accommodation is achieved, the program attempts to provide DTV channels for all vacant noncommercial allotments. It will then seek to find a new NTSC channel to accommodate each vacant noncommercial allotment.

LPTV and Translators. Coverage of existing low power stations and translators are not considered in the assignment process, but many of them may still be able to continue operating after the DTV channels are assigned. No DTV channels are assigned to LPTV stations, or translators, but in some cases there may be sufficient spectrum to enable translators and LPTV stations to transmit DTV services as well.

#### **IV. Limitations**

The model can understate NTSC and DTV coverage where there are little terrain blockages and large market-to-market spacing. The area calculated using F (50,90) propagation curves with the adjusted signal strength minimum level for each channel is the maximum obtainable; even if the Longley-Rice propagation model predicts a signal level above the Grade B threshold beyond that boundary.

The minimum co-channel spacing is a fixed parameter. The optimization model only considers channels present in its selection file that satisfy the minimum spacing. Manual selection of a channel or channels where known significant terrain blocking exists (e.g., mountain ranges) can be made and coverage reevaluated for interference impacts.

#### **VI. Audit Trail**

Each run will have the following supporting documentation:

- Job name/date/time
- File name of NTSC summary file
- File name of DTV summary file
- Study type
- Assignment model file used
- Channel relationships with respect to protected station for NTSC to NTSC

Channel relationships with respect to protected station for DTV to NTSC  
Channel relationships with respect to protected station for DTV to DTV  
Channel relationships with respect to protected station for NTSC to DTV

for: Co-channel, adjacent channel and non-adjacent channel protection ratios applied

NTSC to NTSC  
DTV to NTSC  
DTV to DTV  
NTSC to DTV

List of service contour levels for DTV and NTSC  
Transmit antenna pattern for NTSC station used: yes/no  
Transmit antenna pattern for DTV station used: yes/no  
Receive antenna patterns considered: yes/no/file name  
Separation violations' control report

## **Appendix A: Planning Factors Used for DTV**

### **I. System Independent Planning Factors Recommended by the Advisory Committee**

<b><u>Planning Factor</u></b>	<b><u>Low VHF</u></b>	<b><u>High VHF</u></b>	<b><u>UHF</u></b>
Geometric mean frequency (MHz)	69	194	615
Dipole Factor (dBm-dBu) dB ( $K_d$ )	-111.8	-120.8	-130.8
Thermal noise (dBm) ( $N_t$ )	-106.2	-106.2	-106.2
Antenna Gain (dB) ( $G$ )	4	6	10
Downlead line loss for 50 ft. (15 m.) of coax (dB) ( $L$ )	1	2	4
Front-to-back ratio (dB) (ratio of forward gain to maximum response over rear 180°)	10*	12*	14*
Receiver noise figure (dB) ( $N_R$ )	10	10	10**
Time probability factor for 90° availability (dB) ( $dT$ )	***	***	***
Location probability for (dL) 50% availability (dB)	0	0	0

\* For the receiving antenna manufacturer's objectives the values are 14, 16, and 20.

\*\* Broadcasters propose a 7dB noise figure for the UHF band.

\*\*\* The time probability factor is defined as the difference  $F(50,10)$  minus  $F(50,50)$ , where these two values are determined from the FCC charts in Section 73.699. This factor is a function of the distance between the transmitting and receiving antennas.

**Appendix B: D/U Ratio of the Grand Alliance System**

<u>Parameter</u>	<u>Measured Value (dB)</u>
Carrier-to-Noise Ratio	+15.19
Co-channel D/U Ratio	
DTV-into-NTSC	+34.44
NTSC-into-DTV	+1.81
dtv-into-DTV	+15.27
Adjacent D/U Ratio	
Lower DTV-into-NTSC	-17.43
Upper DTV-into-NTSC	-11.95
Lower NTSC-into-DTV	-47.73
Upper NTSC-into-DTV	-48.71
Lower DTV-into-DTV	-41.98
Upper DTV-into-DTV	-43.17
Taboo D/U Ratio, DTV-into-NTSC	
N-2	-23.73
N+2	-27.93
N-3	-29.73
N+3	-34.13
N-4	-34.00*
N+4	-24.96
N-7	-35.00*
N+7	-34.00*
N-8	-31.62
N+8	-43.22
N+14	-33.38
N+15	-30.58
Taboo D/U Ratio, NTSC-into-DTV	
N-2	-62.45
N+2	-59.86
N-3	< -61.49
N+3	< -62.49
N-4	-58.00*
N+4	-58.00*
N-7	-58.00*
N-8	-58.00*
N+8	-58.00*
N+14	-58.00*
N+15	-58.00*

**Appendix B: D/U Ratio of the Grand Alliance System**

Taboo D/U Ratio, DTV-into-DTV	
N-2	-60.52
N+2	-59.13
N-3	< -60.61
N+3	< -61.53
N-4	-58.00*
N+4	-62.00*
N-7	-63.00*
N+7	-63.00*
N-8	-63.00*
N+8	-63.00*
N+14	-63.00*
N+15	-63.00*

**Appendix C: Vertical Antenna Pattern for NTSC and DTV Transmitting Facility**

Vertical plane relative field values were obtained from manufacturers' catalogs for the power gains specified.

<b>VERTICAL ANTENNA PATTERNS</b>					
Degrees Below Horizontal	<b>Relative Field Strength</b>				
	<b>Low VHF</b>	<b>High VHF</b>		<b>UHF</b>	
	<b>NTSC/DTV</b>	<b>NTSC</b>	<b>DTV</b>	<b>NTSC</b>	<b>DTV</b>
0.75	1.00	1.00	1.00	1.00	1.00
1.50	1.00	0.95	0.97	0.74	0.88
2.00	0.99	0.86	0.94	0.52	0.69
2.50	0.98	0.73	0.89	0.33	0.46
3.00	0.97	0.60	0.82	0.22	0.26
3.50	0.95	0.47	0.73	0.17	0.18
4.00	0.93	0.36	0.65	0.15	0.21
5.00	0.88	0.30	0.47	0.13	0.20
6.00	0.82	0.37	0.33	0.10	0.08
7.00	0.74	0.37	0.27	0.11	0.11
8.00	0.637	0.31	0.28	0.10	0.07
9.00	0.57	0.22	0.28	0.10	0.09
10.0	0.48	0.17	0.25	0.11	0.15



## **APPENDIX E2**

### **MODIFIED DTV ALLOTMENT/ASSIGNMENT PLAN DESCRIPTION OF TABULATED DATA**

<b>Column No.</b>	<b>Description</b>
1	Station "Call Sign" followed by the "City" and "State" of a licensed facility. A call sign with the letter "NEW" refers to a pending application or CP that was accepted for filing prior to the 1992 cut-off date.
2	NTSC channel number.
3	DTV channel number. A "0" channel number indicates that the NTSC facility is not eligible for a DTV assignment.
4	DTV Effective Radiated Power (ERP) in kilowatts. Using DTV planning factors recommended by ACATS, the DTV power is calculated to achieve replication of the NTSC noise-limited contour.
5	"Height Above Average Terrain" (HAAT) in meters. The HAAT for both NTSC and DTV is assumed to be the same. <u>The HAAT data was computed using a 3 second terrain database.</u>
6	The "DTV Service Area" in square kilometers is defined as the area within the noise-limited contour reduced by the areas where service is deemed to be unacceptable because of interference from other DTV and NTSC stations and/or terrain as predicted by the Longley-Rice methodology.
7	The total population within the DTV service area. The population statistics were rounded off to the nearest 1,000.
8	The population affected within the DTV interference area in percent relative to the population within the noise-limited area.
9	The "NTSC Service Area" in square kilometers is defined as the area within the noise-limited contour reduced by the areas where service is deemed to be unacceptable because of interference from other NTSC stations and/or terrain as predicted by the Longley-Rice methodology.

**MODIFIED DTV ALLOTMENT/ASSIGNMENT PLAN**  
**DESCRIPTION OF TABULATED DATA**  
(continued)

<b>Column No.</b>	<b>Description</b>
10	The total population within the NTSC service area. The population statistics were rounded off to the nearest 1,000.
11	The "New NTSC Interference" area in percent relative to the noise-limited area is defined as any reduction of the NTSC service area due to interference from DTV assignments.
12	The population affected within the new NTSC interference area in percent relative to the population within the noise-limited area.
13	"Percent Matching" is the percentage of existing acceptable NTSC viewing locations that will also receive DTV service. This percentage can not be greater than 100%. However, since the DTV and NTSC service areas may be shaped differently, due to propagation factors, the total service area of DTV may be larger than the NTSC service area and yet not achieve 100% replication.